GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS

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GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS

PREPARED
FOR
CONTROL DATA CORPORATION
MINNEAPOLIS, MN 55440

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GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS

RECOMMENDATIONS

- DEVELOP SHORT RANGE PLANS TO SUPPLY UNISTRUC ON A DISTRIBUTED DATA PROCESSING BASIS USING A 32 BIT MINICOMPUTER
  - PRE AND POSTPROCESSING ON MINICOMPUTER.
  - SIMPLE STRUCTURAL ANALYSIS ON MINICOMPUTER WITH ADD-ON CAPABILITY
  - COMPLEX STRUCTURAL ANALYSIS VIA REMOTE BATCH THROUGH CYBERNET
- STRUCTURE THE PRODUCT FOR USE IN BOTH A STRUCTURAL DESIGN AND ANALYSIS ENVIRONMENT

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GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

RECOMMENDATIONS (Cont.)

- INTERFACE UNISTRUC ON MINI WITH CAD/CAM SYSTEMS
  - USE COMMON DATA BASE EXTRACTION-TRANSFER APPROACH
  - USE COMMON GRAPHICS TERMINALS
  - USE COLOR GRAPHICS AS A LATER ADD-ON
- FOR LONG-RANGE PLANNING INVESTIGATE IMPLEMENTING UNISTRUC ON THE MOST EFFECTIVE CAD/CAM MINICOMPUTER SYSTEM
  - APPLICON, COMPUTERVISION, GERBER, ETC.
  - MOST COST EFFECTIVE FOR END USER
  - TIES IN CYBERNET TO BOTH CAD AND COMPUTER AIDED STRUCTURAL ANALYSIS

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS

- UNISTRUC
  - USED BY 20% OF RESPONDENTS
  - RESPONDENTS UNIFORMELY PLEASED WITH CAPABILITIES
  - SOME FOUND SYSTEM TOO EXPENSIVE TO USE FOR ALL BUT THE MOST COMPLEX STRUCTURES
- THE COMPUTER AIDED STRUCTURAL ANALYSIS MARKET IS BEING IMPACTED BY THE MINICOMPUTER, IN PARTICULAR THE DEC VAX11/780

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- VENDOR SUPPLIED SOFTWARE AND IBM MAINFRAMES ARE THE PRIMARY TOOLS FOR DOING COMPUTER ASSISTED STRUCTURAL DESIGN IN-HOUSE
  - OVER 70% USE SOFTWARE PACKAGES
  - NEARLY 50% USE IBM MAINFRAMES
  - ABOUT 25% USE CDC MAINFRAMES
- VENDOR SUPPLIED SOFTWARE AND CDC MAINFRAMES ARE THE WAY USERS ACCOMPLISH COMPUTER ASSISTED STRUCTURAL DESIGN ON A RCS BASIS
  - NEARLY 90% USE CYBERNET SERVICES

INPUT

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- VENDOR SUPPLIED SOFTWARE AND IBM MAINFRAMES ARE THE PRIMARY TOOLS FOR DOING COMPUTER ASSISTED STRUCTURAL ANALYSIS IN-HOUSE
  - NEARLY 85% USE SOFTWARE PACKAGES
  - NEARLY 50% USE IBM MAINFRAMES
  - ABOUT 25% USE CDC MAINFRAMES
- VENDOR SUPPLIED SOFTWARE AND CDC MAINFRAMES ARE THE WAY USERS ACCOMPLISH COMPUTER ASSISTED STRUCTURAL ANALYSIS ON A RCS BASIS
  - OVER 75% USE CYBERNET SERVICES

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- RESPONDENTS USE FINITE ELEMENT SOFTWARE FOR STRUCTURAL DESIGN AS WELL AS FOR STRUCTURAL ANALYSIS
  - ANSYS, SUPERB, AND SAGS WERE THE MOST FREQUENTLY USED
- AN EFFECTIVE PRE AND POSTPROCESSOR MUST INTERFACE WITH AT LEAST THE FOLLOWING STRUCTURAL ANALYSIS PROGRAMS
  - NASTRAN
  - ANSYS
  - SUPERB
  - STRUDL

INPUT

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- AN EFFECTIVE PRE AND POSTPROCESSOR FOR FINITE ELEMENT STRUCTURAL ANALYSIS MUST HANDLE AT LEAST STATIC AND DYNAMIC ANALYSIS EQUALLY WELL
  - NEARLY 60% OF RESPONDENTS DO BOTH
  - OVER 20% DO OTHER TYPES SUCH AS NON-LINEAR AND THERMAL
- AN EFFECTIVE PRE AND POSTPROCESSOR FOR FINITE ELEMENT STRUCTURAL ANALYSIS MUST HANDLE ALL DIMENSION TYPES EQUALLY WELL
  - THIRTY-FOUR PERCENT OF RESPONDENTS USE ONE DIMENSION
  - THIRTY-FIVE PERCENT OF RESPONDENTS USE TWO DIMENSIONS
  - THIRTY-ONE PERCENT OF RESPONDENTS USE THREE DIMENSIONS

INPUT

GRAPHICS SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- BEAM IS THE MOST IMPORTANT ONE-DIMENSIONAL TYPE USED BY RESPONDENTS
  - SIXTY-SEVEN PERCENT USE BEAMS
  - FIFTY-ONE PERCENT USE SPRING
  - FIFTY-ONE PERCENT USE GAP
  - FORTY-FIVE PERCENT USE RODS
- TRIANGULAR AND QUADRILATERAL WITH ONE MIDSIDE NODE ARE THE MOST IMPORTANT TWO-DIMENSIONAL ELEMENT TYPES USED BY RESPONDENTS
  - FORTY-SEVEN PERCENT USE TRIANGULAR WITH ONE MIDSIDE NODE
  - FIFTY-THREE PERCENT USE QUADRILATERAL WITH ONE MIDSIDE NODE
- BRICK IS THE MOST IMPORTANT THREE-DIMENSIONAL ELEMENT TYPE
  - FIFTY-FIVE PERCENT USE BRICK
  - FORTY-FIVE PERCENT USE WEDGE

INPUT

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- AN EFFECTIVE PRE AND POSTPROCESSOR FOR FINITE ELEMENT STRUCTURAL ANALYSIS MUST HANDLE A WIDE RANGE OF NODES AND ELEMENTS:
  - NUMBER OF NODES BETWEEN 10-10,000
  - NUMBER OF ELEMENTS BETWEEN 10-5,000
- GEOMETRY DATA GENERATION IS MUCH MORE IMPORTANT THAN NON-GEOMETRY DATA GENERATION IN A PRE AND POSTPROCESSOR FOR FINITE ELEMENT STRUCTURAL ANALYSIS
  - SEVENTY-FIVE PERCENT OF USERS FELT IT IS AT LEAST TWICE AS IMPORTANT
  - THIRTY-FIVE PERCENT FELT IT TO BE AT LEAST SIX TIMES MORE IMPORTANT

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- GREATER PRODUCTIVITY CAN BE GAINED IN THE PRE-PROCESSING PHASE
  - SIXTY-FIVE PERCENT OF USER STRUCTURAL ANALYSIS IS DEVOTED TO PREPROCESSING
- LITTLE AUTOMATED INTERFACE CURRENTLY EXISTS BETWEEN COMPUTER AIDED STRUCTURAL DESIGN AND COMPUTER AIDED STRUCTURAL ANALYSIS
  - FOR 60% OF RESPONDENTS, LESS THAN 10% OF ALL DRAWINGS ARE CAD PRODUCED

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- THERE IS A RAPIDLY GROWING MARKET IN COMPUTER AIDED STRUCTURAL DESIGN:
  - SEVENTY-FIVE PERCENT OF USERS SEE NEED TO IMPROVE PRODUCTIVITY
  - TWENTY-FIVE PERCENT OF USERS WERE ACTIVELY PLANNING TO ACQUIRE NEW COMPUTER ASSISTED AIDS
  - TWENTY-FIVE PERCENT OF USERS WERE INSTALLING NEW MIDSIZE DEDICATED SYSTEMS INCLUDING DEC/VAX
  - SEVENTY PERCENT OF TOTAL RESPONDENT ENGINEERING EFFORT WAS DEVOTED TO DESIGN VERSUS STRUCTURAL ANALYSIS
- LINK COMPUTER ASSISTED DESIGN AND COMPUTER ASSISTED STRUCTURAL ANALYSIS SYSTEMS IN THE NEAR TERM THROUGH:
  - COMMON TERMINAL SUBSYSTEMS
  - COMMON DATA BASES
  - PRE AND POSTPROCESSORS IN A DISTRIBUTED PROCESSING OR STANDALONE CONFIGURATION

INPUT

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- LINK PRE AND POSTPROCESSING SYSTEMS AT THE DATA INPUT/OUTPUT LEVEL
  - TWENTY-THREE PERCENT OF RESPONDENTS FOR DATA TRANSFER ON REMOTE BATCH BASIS
  - TWENTY-SEVEN PERCENT FOR INDEPENDENCE EXCEPT FOR TRANSLATION ROUTINES
- MINICOMPUTERS CAN BE USED FOR COMPLEX STRUCTURAL ANALYSIS
  - SIXTEEN BIT PROCESSORS ARE NOT ADEQUATE
  - FIFTY PERCENT OF USERS HAVE PLAN TO USE 32 BIT MINICOMPUTERS INCLUDING DEC/VAX

GRAPHICS SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- COLOR GRAPHICS ARE IMPORTANT BUT NOT YET DEFINED
  - SIXTY-FIVE PERCENT OF USERS WANT COLOR GRAPHICS
  - THIRTY-FIVE PERCENT DON'T KNOW DEGREE OF PRODUCTIVITY IMPROVEMENT
  - THIRTY PERCENT BELIEVE IT WILL IMPROVE PRODUCTIVITY BY AT LEAST 10%
- INTERACTIVE TERMINALS WILL NOT BE EFFECTIVE IF USER BECOMES SLAVE TO THE SYSTEM
  - MAXIMUM TWO-FIVE SECONDS RESPONSE FOR MOST INTERACTIONS
  - LARGE MESH LESS THAN 60 SECONDS
  - ANIMATION UP TO 30 SECONDS

INPUT

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- FEATURES HAVING HIGHEST PRIORITY IN DEVELOPING A PRE AND POSTPROCESSING SYSTEM FOR STRUCTURAL ANALYSIS ARE:
  - SURFACE INTERSECTION
  - SEMI AUTOMATED MESHING
  - FULLY AUTOMATED REMESHING
  - LABELING NODES AND ELEMENTS
  - BOUNDARY DISPLAY
  - PLANARITY CHECK
  - LABELING PROPERTY AND MATERIALS
  - LOAD CASE COMBINATION
  - CONTOUR PLOTS
  - X-Y PLOTS
  - MAX/MIN SEARCHES
  - CONSTRAINTS
  - LOADS
  - OUTPUT OPTIONS
  - BAND WIDTH/WAVE FRONT OPTIMIZER

INPUT

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS (Cont.)

FINDINGS (Cont.)

- PRE AND POSTPROCESSING FEATURES HAVING LOWEST DEVELOPMENT PRIORITY ARE:
  - PARAMETRIC MODELING
  - DIGITIZING DATA VIA TABLET
  - MULTIPLE SPLIT SCREEN DISPLAY
  - HIDDEN LINE REMOVAL
  - DATA SORTING
  - DESIGN CODE PROCESSING
  - STANDARD MEMBER TABLES

INPUT

RESPONDENTS' USE OF STRUCTURAL DESIGN COMPUTER ASSISTED AIDS

PRODUCT	PORTION OF RESPONDENTS - (PERCENT)						
	SOFTWARE PRODUCTS		COMPUTER SYSTEM				
			IN-HOUSE			RCS	
	DEVELOPED IN-HOUSE	VENDOR SUPPLIED	CDC	IBM	OTHER	CDC	OTHER
1	29%	71%	15%	33%	19%	33%	0%
2	29	71	21	21	14	36	8
3	17	83	8	33	18	33	8
AVERAGE	26%	74%	15%	30%	17%	34%	4%

RESPONDENTS' USE OF STRUCTURAL ANALYSIS COMPUTER ASSISTED AIDS

PRODUCT	PORTION OF RESPONDENTS - (PERCENT)						
	SOFTWARE PRODUCTS		COMPUTER SYSTEM				
			IN-HOUSE			RCS	
	DEVELOPED IN-HOUSE	VENDOR SUPPLIED	CDC	IBM	OTHER	CDC	OTHER
1	17%	83%	10%	20%	17%	43%	10%
2	20	80	10	20	5	45	20
3	6	94	12	21	12	44	11
AVERAGE	15%	85%	10%	21%	12%	44%	13%

RESPONDENTS' USE OF SOFTWARE PRODUCTS FOR COMPUTER ASSISTED DESIGN AND ANALYSIS

SOFTWARE PRODUCT	NUMBER OF RESPONDENTS	
	STRUCTURAL DESIGN	STRUCTURAL ANALYSIS
NASTRAN	3	10
AD 2000	3	
ANSYS	6	17
EASE 2		3
STARDYNE	1	3
MARC		2
SAGS	4	4
SUPERB	6	9
SPAR		2
CADAM	1	
DAGS	1	1
SUPERTAB	2	3
STRUDL	1	7
IMAGE	1	
ADINA	1	1
APPLICON	1	
BOSOR 4	1	1
COMPUTERVISION	2	
UNISTRUC		6
MSG MESH		1
NISA		1

GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS

RESPONDENTS' USE OF FINITE ELEMENT ANALYSIS BY TYPE AND DIMENSION

TYPE	USE	PORTION USED			
		PRODUCT 1 (PERCENT)	PRODUCT 2 (PERCENT)	PRODUCT 3 (PERCENT)	PRODUCT ALL (PERCENT)
TYPE OF ANALYSIS	STATIC	26%	6%	20%	19%
	DYNAMIC	0	0	0	0
	BOTH	52	78	53	59
	THERMAL	6	11	20	11
	OTHER	16	5	7	11
DIMENSION TYPE	ONE DIMENSIONAL	34%	36%	34%	34%
	TWO DIMENSIONAL	34	32	38	35
	THREE DIMENSIONAL	32	32	28	31

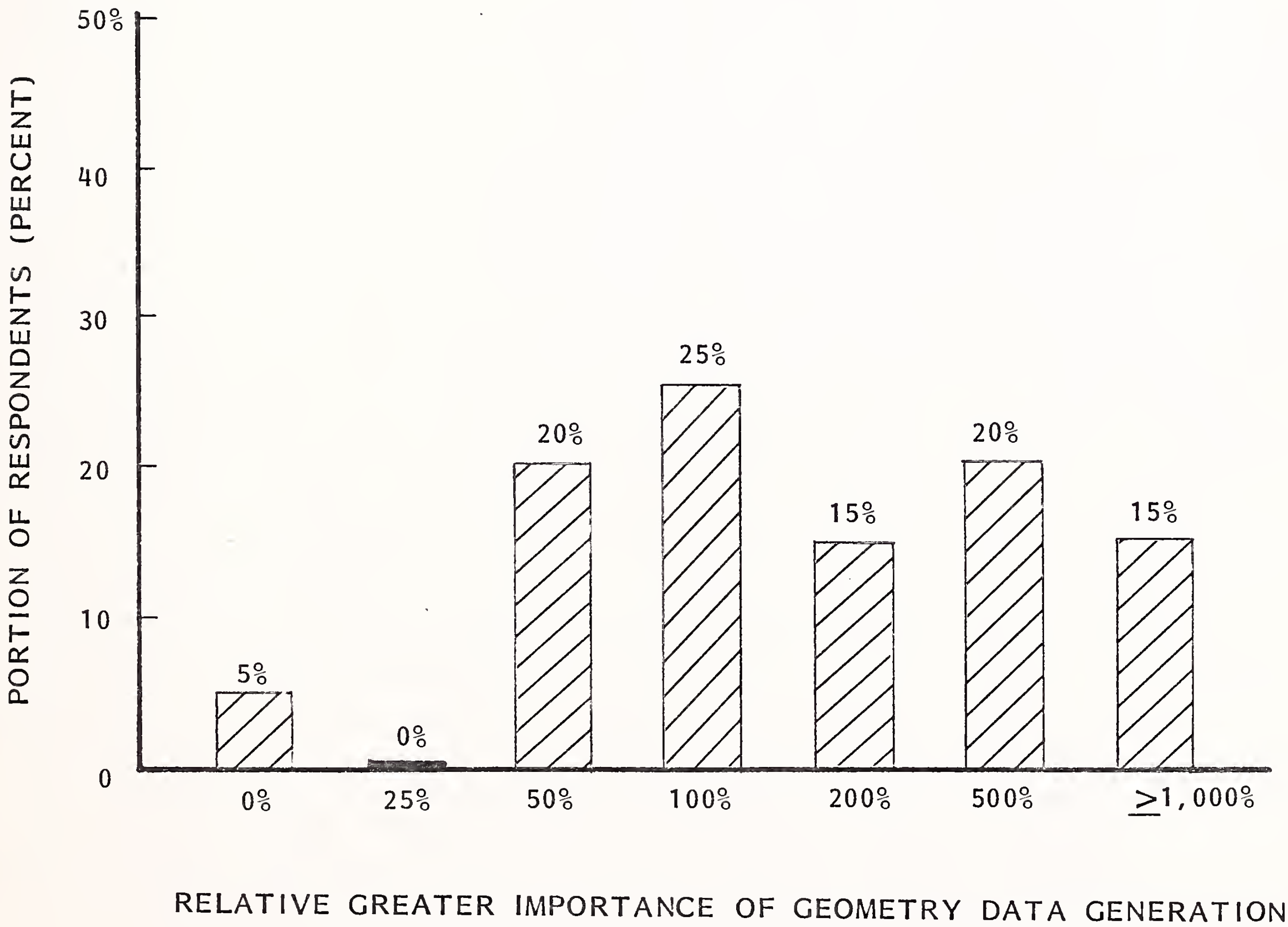
RESPONDENTS' USE OF FINITE ELEMENT TYPES BY DIMENSION

DIMENSION TYPE	ELEMENT TYPE	PORTION USED			
		PRODUCT 1 (PERCENT)	PRODUCT 2 (PERCENT)	PRODUCT 3 (PERCENT)	PRODUCT ALL (PERCENT)
ONE DIMEN-SIONAL	ROD	45%	47%	42%	45%
	SPRING	59	47	42	51
	BEAM	68	67	67	67
	GAP	64	43	42	51
	OTHER	9	13	17	12
TWO DIMEN-SIONAL	TRIANGULAR				
	- NO MIDSIDE NODE	18%	7%	17%	14%
	- ONE MIDSIDE NODE	41	47	58	47
	- TWO MIDSIDE NODES	23	20	33	24
	QUADRILATERAL	55	40	67	53
	OTHER	23	20	17	18
THREE DIMEN-SIONAL	PYRAMID	23%	20%	25%	22%
	WEDGE	41	47	50	45
	BRICK	59	53	50	55
	ONE MIDSIDE NODE	45	13	25	31
	TWO MIDSIDE NODES	18	7	17	14
	JOINT	5	7	0	4
	OTHER	14	13	8	10

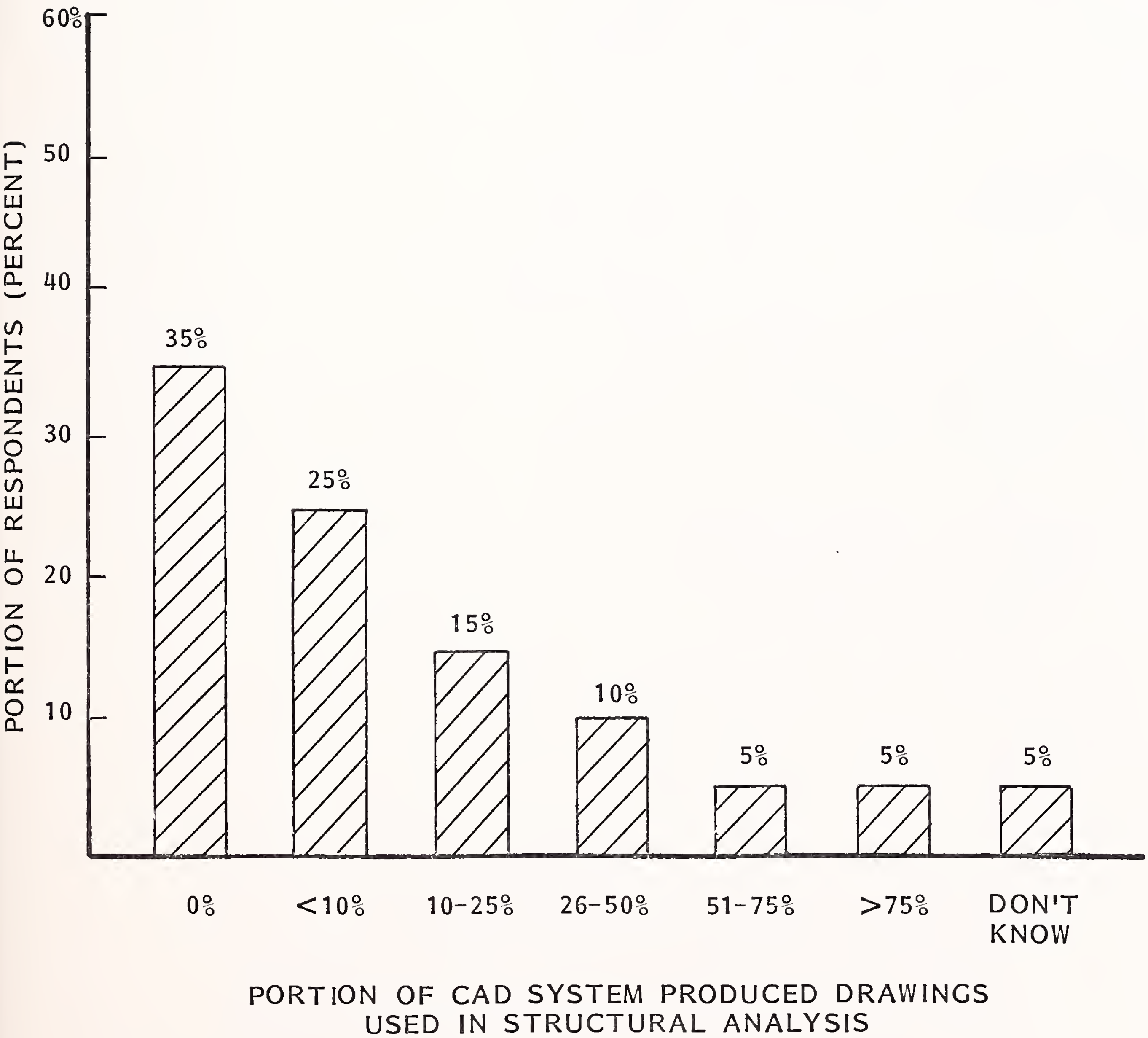
TYPICAL SIZE OF STRUCTURAL ANALYSIS MODELS
AS REPORTED BY RESPONDENTS

PRODUCT	NUMBER OF RESPONDENTS	TYPICAL SIZE			
		NODES		ELEMENTS	
		AVERAGE NUMBER	RANGE	AVERAGE NUMBER	RANGE
1	26	1,950	10-10,000	1210	10-5,000
2	16	770	100-2,000	670	100-2,000
3	13	800	100-2,500	780	125-2,600

RELATIVE IMPORTANCE OF GEOMETRY VERSUS
NON-GEOMETRY DATA GENERATION
IN STRUCTURAL ANALYSIS PRE AND POSTPROCESSOR SYSTEMS
AS REPORTED BY RESPONDENTS

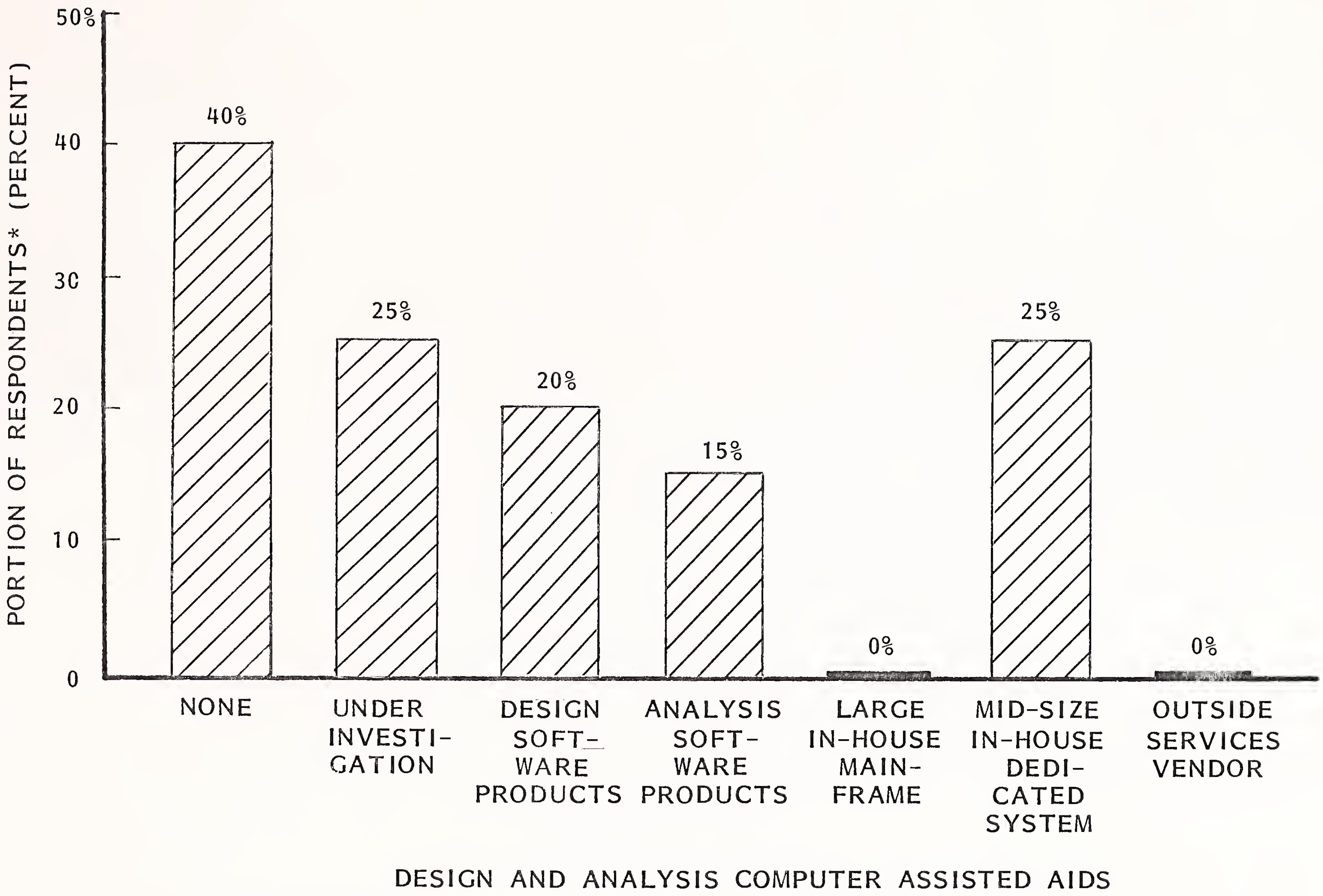


RESPONDENTS' ESTIMATE OF CAD SYSTEM PRODUCED DRAWINGS USED IN STRUCTURAL ANALYSIS



GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS

RESPONDENTS' PLANS FOR ACQUIRING NEW DESIGN AND ANALYSIS COMPUTER ASSISTED AIDS



*MULTIPLE RESPONSES POSSIBLE

ABILITY OF MINICOMPUTERS TO HANDLE COMPLEX STRUCTURAL ANALYSIS PROGRAMS AS PERCEIVED BY RESPONDENTS

PERCEPTION	PERCENT OF RESPONDENTS		
	YES	NO	DON'T KNOW
ABILITY OF MINICOMPUTERS TO HANDLE	70%	30%	0%
ADEQUACY OF 16 BIT PROCESSOR	15	55	30
PLANS TO USE MINICOMPUTERS FOR STRUCTURAL ANALYSIS	50	50	0

RESPONDENTS' COMMENTS ON PLANS TO USE MINICOMPUTERS FOR STRUCTURAL ANALYSIS

"We are conducting a survey of computers including super-minis."

"We are considering something like the VAX 11/780 super-mini."

"If the minicomputer has several magabytes of CPU memory."

"Probably go to MIDIS like VAX."

"VAX or Prime will take over as distributed machines over the next five years."

"We will use mini/micros for input file editing and submission."

"We will use minis to do dynamic structural analysis/testing."

"If we can obtain funds to change to distributed processing."

"We will use minis for pre and postprocessing. We will upgrade to CYBER 171/173 for analysis."

"We are getting a departmental VAX 11/780."

DIVISION OF LABOR BETWEEN DESIGN AND STRUCTURAL ANALYSIS AS REPORTED BY RESPONDENTS

ENGINEERING FUNCTION	PORTION PERCENT	
	AVERAGE	RANGE
DESIGN	70%	10-99%
ANALYSIS	30	1-90
- PREPROCESSING	65	20-90
- POSTPROCESSING	35	10-80

FEATURES WHICH RESPONDENTS CONSIDER MOST HELPFUL IN IMPROVING PRODUCTIVITY IN THE PREPROCESSING PHASE OF STRUCTURAL ANALYSIS

FEATURES	NUMBER OF RESPONDENTS
SIMPLIFY PROCESS OF MESH GENERATION	4
GENERATE 2/3-D VIEWS OF GEOMETRIC INPUT	4
INERACTIVE GRAPHICS FOR GEOMETRY GENERATION	3
MODELING AND MESH GENERATION COMPATIBILITY WITH CAD SYSTEMS	2
BE ABLE TO MAKE FEASIBILITY STRUCTURAL MODEL DIRECTLY FROM CAD CRT DRAWINGS	2
GENERATE 95% OR MORE OF INPUT FOR NASTRAN, STARDYNE, ETC.	2
USER FRIENDLY INTERACTIVE GRAPHICS AND FILE SYSTEMS	2

FEATURES WHICH RESPONDENTS' CONSIDER MOST HELPFUL IN IMPROVING PRODUCTIVITY IN THE POSTPROCESSING PHASE OF STRUCTURAL ANALYSIS

FEATURE	NUMBER OF RESPONDENTS
INTERACTIVE SYSTEM FOR PLOTTING DEFORMED STRUCTURES, DISPLAY CONTOUR AND FUNCTION PLOTS	6
SIMPLIFY CREATION OF POST-PROCESSING PLOTS	4
DEFORMED GEOMETRY WITH STRESS CONTOUR PLOTS	3
DISPLAY DEFORMED RELATIVE TO ORIGINAL STRUCTURE	2
USE OF SUPERPOSITION TO VISUALIZE STRESS OUTPUT	2
INCREASE LINE RATES TO 9600 BPS FOR FASTER DISPLAY/PRINTOUT	2

LEVEL THAT PRE AND POSTPROCESSING SYSTEMS SHOULD BE LINKED TO STRUCTURAL ANALYSIS PROGRAMS AS REPORTED BY RESPONDENTS

LEVEL	NUMBER OF RESPON-DENTS
SHOULD BE INDEPENDENT EXCEPT FOR TRANSLATION ROUTINES	6
SHOULD BE LINKED AS IF PART OF ONE PROGRAM	6
FORMAT AND ORDER DATA FOR ALL MAJOR FINITE ELEMENT ANALYSIS PROGRAMS. SUBMIT FILE FOR BATCH RUN	5
SHOULD BE LINKED ONLY BY COMMON DATA BASE	2

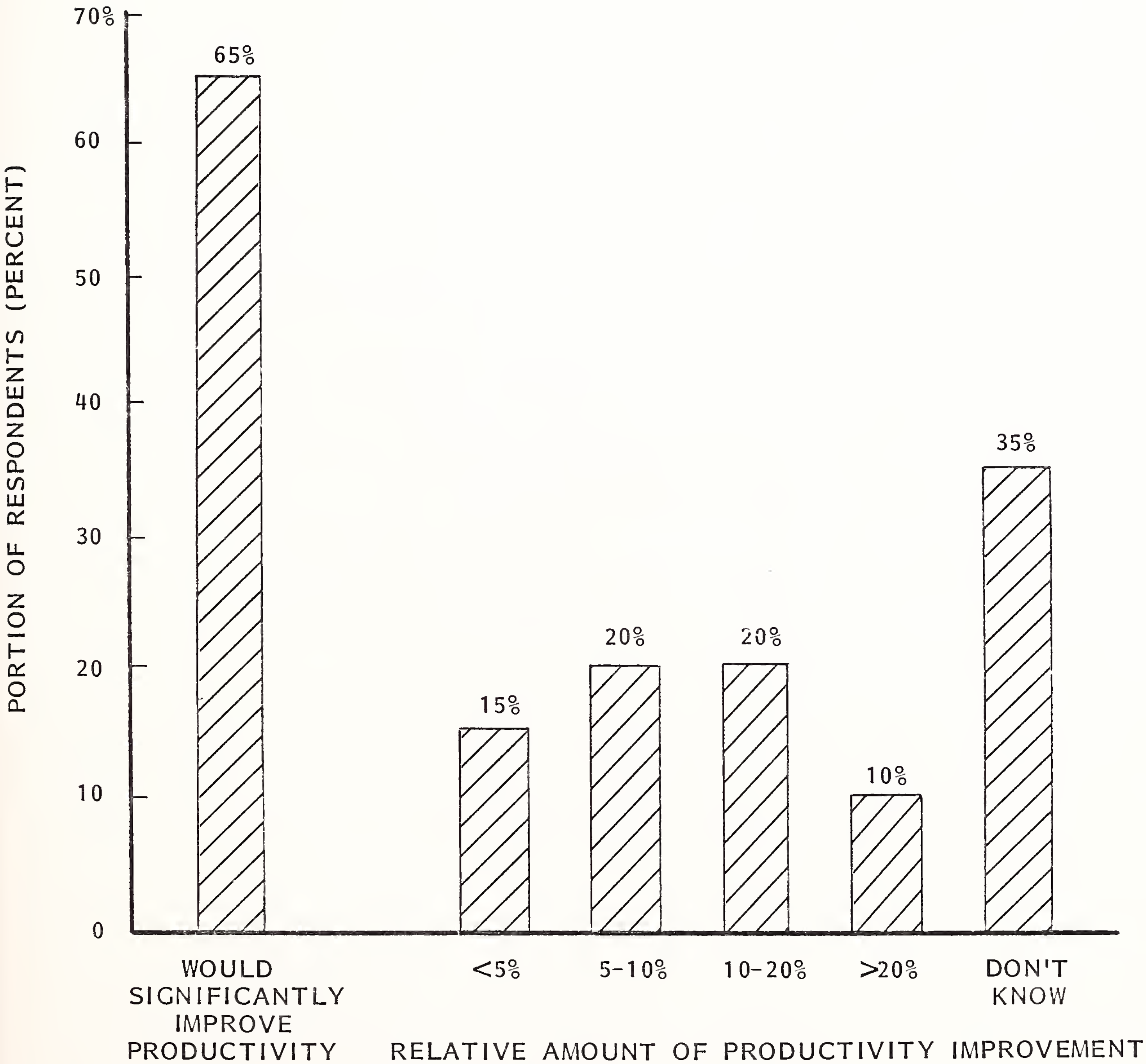
RESPONDENTS' POSITION ON SELECTED ISSUES RELATED TO COMPUTER AIDED DESIGN AND ANALYSIS

ISSUE	PORTION OF RESPONDENTS PERCEIVING (PERCENT)
NEED FOR SIGNIFICANT PRODUCTIVITY IMPROVEMENT IN THE STRUCTURAL ANALYSIS PHASE	75%
NECESSITY FOR INTEGRATING DESIGN AND ANALYSIS INTO A SINGLE COMPUTER AIDED SYSTEM	72
PRE AND POSTPROCESSORS REMAINING IN A STANDALONE CONFIGURATION.	52

LEVEL THAT COMPUTER AIDED STRUCTURAL ANALYSIS SYSTEMS
SHOULD BE LINKED TO
COMPUTER AIDED STRUCTURAL DESIGN
AS REPORTED BY RESPONDENTS

LEVEL	NUMBER OF RESPONDENTS
ABILITY OF DESIGN AND ANALYSIS SOFTWARE TO ACCESS A COMMON DATA BASE	6
ACCESS BOTH THE DESIGN AND ANALYSIS SYSTEMS FROM THE SAME TERMINAL	4
INTERFACED TO A MASTER CONTROL PROGRAM WITH A COMMON DATA BASE	2
LINKAGE BETWEEN CAD SYSTEM TO PREPROCESSOR INPUT	2

RESPONDENTS' POSITION ON THE USE OF COLOR GRAPHICS
FOR STRUCTURAL ANALYSIS PRE AND POSTPROCESSING SYSTEMS



GRAPHIC SYSTEMS FOR STRUCTURAL ANALYSIS

RESPONDENTS' POSITION ON TERMINAL RESPONSE TIME REQUIREMENTS FOR INTERACTIVE GRAPHICS USED IN STRUCTURAL ANALYSIS PRE AND POSTPROCESSING SYSTEMS

RESPONSE TIME	NUMBER OF RESPONDENTS
MAXIMUM TOLERABLE IS 2-5 SECONDS	5
AVERAGE RESPONSE TIME IS LESS THAN 10 SECONDS	3
TO BE EFFECTIVE INTERACTIVE GRAPHICS SYSTEMS MUST BE FAST	3
ANIMATION UP TO 30 SECONDS	2
NODE AND MESH GENERATION 2-10 SECONDS	2
FOR GENERATING LARGE MESH, LESS THAN 60 SECONDS	1
ACCEPTABLE RESPONSE TIME 2-3 SECONDS	1
REDRAW LESS THAN 3 SECONDS	1

IMPORTANCE OF PRE AND POSTPROCESSING FEATURES AS REPORTED BY RESPONDENTS

FUNCTION	SYSTEM FEATURE	RATING 0-10*	
		AVERAGE	RANGE
MODEL GENERATION	SURFACE INTERSECTION	7.0	1-10
	PARAMETRIC MODELING	5.7	2-10
	FULLY AUTOMATED MESHING OR REMESHING	7.8	1-10
	SEMI-AUTOMATED MESHING	8.0	5-10
	MANUAL MESHING	5.9	2-10
USER INTERFACE	DIGITIZING DATA VIA TABLET	4.7	0-10
	MENU FUNCTION SELECTION VIA DIGITIZER	5.3	0-10
	MULTIPLE SPLIT SCREEN DISPLAY	4.9	1-10
MODEL VERIFICATION	PLANARITY CHECK	7.2	3-10
	ASPECT RATIO CHECK	6.5	3-10
	BOUNDARY DISPLAY	7.7	4-10
	HIDDEN LINE REMOVAL	5.2	1-10
	ELEMENT SHRINK IN PLOTTING	6.6	1-10
	LABELING NODES AND ELEMENTS	9.1	6-10
	LABELING PROPERTY AND MATERIALS	7.2	1-10

*WHERE 10 IS MOST IMPORTANT

IMPORTANCE OF PRE AND POSTPROCESSING FEATURES AS REPORTED BY RESPONDENTS

FUNCTION	SYSTEM FEATURE	RATING 0-10*	
		AVERAGE	RANGE
NON-GEOMETRIC DATA GENERATION	LOADS	7.5	3-10
	CONSTRAINTS	7.6	2-10
	PROPERTIES	6.1	2-10
	MATERIALS	5.8	2-10
	SOLUTION SELECTION	5.8	0-10
	OUTPUT OPTIONS	7.0	1-10
POST-PROCESSING	X-Y PLOTS	7.8	0-10
	CONTOUR PLOTS	7.8	2-10
	MAX/MIN SEARCHES	7.5	2-10
	DATA SORTING	5.2	0-10
	DESIGN CODE PROCESSING	4.3	0-9
	LOAD CASE COMBINATION	7.5	2-10
	MEMBER SELECTION	5.2	0-10
	ANIMATION OF DYNAMIC RESULTS	5.5	0-10

*WHERE 10 IS MOST IMPORTANT

IMPORTANCE OF PRE AND POSTPROCESSING FEATURES
AS REPORTED BY RESPONDENTS

FUNCTION	SYSTEM FEATURE	RATING 0-10*	
		AVERAGE	RANGE
OTHER	STANDARD MEMBER TABLES	4.2	0-10
	BANDWIDTH/WAVEFRONT OPTIMIZER	8.6	1-10
	PHYSICAL PROPERTY CALCULATION		
	LENGTH	5.5	0-10
	AREA	5.8	0-10
	VOLUME	6.1	0-10
	INERTIA	6.2	0-10
	OTHER		
	BEAM CROSS SECTION DISPLAY	10	-
	BEAM MULTIPLE STRESS	10	-
	VALID BOUNDRY CONDITION CHECK	9	-
	AUTOMATIC PIVOT CHECK	9	-
	DEFORMED GEOMETRY	10	-
	SELECTIVE GEOMETRY - PEEL AWAY LAYERS	10	-

RESPONDENT'S COMMENTS ON THE IMPORTANCE OF THE MESHING FEATURES IN PRE AND POSTPROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Holes, easy sectors, regular shapes, etc. for fully automated meshing."

"Be able to remesh areas of coarse model into fine section with fully automated remeshing."

"If routines are good, 90% of models can be constructed with fully automated meshing."

"Replications must include arbitrary scale, translate and rotate for semi-automated meshing."

"Need ability to specify subregion meshes and transitions. Also an easily used edit or node move capability for fully automated meshing."

"Unistruc replication features are very good for semi-automated meshing."

"Meshing by defining boundary lines or by vertex points for fully automated meshing."

"Want to model with minimum number of elements. Remesh to get better accuracy in areas of stress concentration for fully automated meshing."

"Want mirroring, cyclic symmetry, etc. for semi-automated meshing."

RESPONDENTS' COMMENTS ON THE TYPES OF CONTRAINTS IN PRE AND POSTPROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Enforced displacements."

"Fixed degree of freedom."

"Rotations."

"Should have capability for multiple sets of B.C. for NASTRAN."

"Current constraints are not specific direction-oriented, say Ø in -X direction, free to move in +X direction."

"Fixed supports and regions of known displacements."

"Supports and couples."

"Same as loads-vector directions."

"Geometric constraints on groups of joints."

"Fixed, contraint equation."

RESPONDENTS' COMMENTS ON THE TYPES OF LOAD DATA GENERATION IN PRE AND POST-PROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Directions, value, location, structure weight."

"Often use gravity and/or spin loads. Also pressure with linear variations."

"Pressure."

"Arrows with magnetic forces and moments."

"Pressures, point loads, combinations."

"Concentrated nodal loads, pressures, temperatures."

"Nodal forces and surface pressures."

"Especially vectors and pressures."

"Forces, moments, pressures."

"Concentrated loads and uniform loads."

"All kinds, especially lumped masses from element properties."

"Point forces, pressures, moments."

"Pressures forces, temperatures, film coefficients, body forces."

RESPONDENTS COMMENTS ON KINDS AND TYPES OF OUTPUT OPTIONS IN PRE AND POST-PROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Would like all which are available for postprocessing - distributed geometry, forced response."

"Sets of output, such as stress, keyed to blocks in model."

"Would like to see stress and displacement print and plot with varied format for letters and reports."

"Emphasize interactive processing. Limit printing to full data. Allow users to request prints from displayed regions."

"Forces, displacements, stresses, strains, temperatures, strain energy."

"Post plot specifications."

"Extended stress, strain, slopes."

"Should be able to control quantity of output, selective suppression of output."

"Select nodes and/or elements."

RESPONDENTS' COMMENTS ON KINDS AND TYPES OF X-Y PLOTS DESIRED IN POST-PROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Stress, force, motion, PSD, RS, mode, shape."

"Transient response."

"Stress linearizations."

"Reaction/stress versus time."

"Stress, strain, displacement, user-specified functions of stress, strain and displacement."

"Displacement plots."

"Deformed plots."

"Deformed geometry important."

"Three-dimensional isometric plots with superimposed reference geometry."

"Geometry deflection, eigenvectors, frequency response."

"Time dependent."

RESPONDENTS' COMMENTS ON SOLUTION SELECTION DATA GENERATION IN PRE AND POST-PROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Static, dynamic, nonlinear, buckling, etc."

"Static, dynamic, plastic, etc."

"Substructures generation."

"Linear static."

"Geometric and material nonlinearaity."

"Static: linear, nonlinear materials, large displacement, buckling."

"Dynamic mode, transient modal, transient direct, random steady state."

"Need a convenient edit capability for text to allow direct input of specific data required by analysis program.

"Static, dynamic, forced response."

"Static, eigenvalue solutions should be mandatory."

"Static, normal nodes, heat conditions, nonlinear transient, buckling."

RESPONDENTS' COMMENTS ON TYPES OF CONTOUR PLOTS DESIRED IN POST-PROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Need to interpret model."

"Most principle strain, energy, density."

"Stress."

"Must be end user specified."

"With smoothing capability."

"Stress contours."

"Stress, strain, displacement, user specified, yield zones."

"Stress, strain, temperature, strain energy."

"Stress, distortion, thermal gradient."

"Displacement, stress, temperature."

"Stress."

"Stress and temperature."

"Developed views."

"Stress contours."

"Stress deflections."

"Two-dimensional/three-dimensional slices through solids."

RESPONDENTS' COMMENTS ON TYPES OF DESIGN CODE PROCESSING DESIRED IN POST-PROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Building codes."

"Could be a big time saver."

"ASME nuclear."

"ANSYS, SUPERB, NISA, SAGS, DAGS."

"Not used in our products."

"ASME mostly."

"NASTRAN, ANSYS, SUPERB."

"Margin of safety for models with multiple material types."

"AISC, ACI, User specified."

"ASME N47."

RESPONDENTS' COMMENTS ON STANDARD MEMBER TABLES DESIRED IN PRE AND POST-PROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Basic rectangular, tube, and general cross section."

"Automated beam property generation T, O, Z, [I, L, □ □ with full stress analysis at ends."

"We rarely use standard members."

"It is not useful for our products."

"Latest AISC steel handbooks."

RESPONDENTS' COMMENTS ON ADDITIONAL OTHER FEATURES DESIRED IN PRE AND POST-PROCESSING SYSTEMS FOR STRUCTURAL ANALYSIS

"Automated element remesh based on strain energy density rules."

"Deformed geometry with deformed, undeformed overlays."

"Selective geometry sections with peel-away layers."

"Beam multiple stress recovery points with combined stresses."

"More number packing and renumbering in combining sub-structures."

"Valid boundary conditions - i.e. check stability for static runs."

"Automatic point check for any beams in structure."

CATALOG NO. YUNI

In completing the questionnaire, please distinguish between the design phase during which a product, part or system is architected and the structural analysis phase, during which the structural characteristics of the system are determined.

---

1. Please briefly describe the current method and computer aided systems used for design and analysis of up to three of your company's principal products.

   a. Product Description:

      Product 1 ____

      ____

      ____

      Product 2 ____

      ____

      ____

      Product 3 ____

      ____

      ____

INPUT

CATALOG NO. Y U N I

1.b. Briefly describe the design process and list computer assisted systems used:

Product 1 ______________________________

____

____

Product 2 ______________________________

____

____

Product 3 ______________________________

____

____

Product	Design Computer Assisted Aids					
	Software Products		Computer System			
	Name	Vendor	Vendor	Model	In-House	Outside Service Vendor
1. ______						
2. ______						
3. ______						

INPU

1.c. Briefly describe the structural analysis process, and list computer assisted systems used:

Product 1 ____________________

____

____

Product 2 ____________________

____

____

Product 3 ____________________

____

____

Product	Structural Analysis Computer Assisted Aids					
	Software Products		Computer System			
	Name	Vendor	Vendor	Model	In-House	Outside Service Vendor
1. ______						
2. ______						
3. ______						

INPUT

1.d. Please describe the characteristics of the finite element analysis used for each product:

		PRODUCT 1 (Check if used)		PRODUCT 2 (Check if used)		PRODUCT 3 (Check if used)	
Type of Analysis	Static	☐		☐		☐	
	Dynamic	☐		☐		☐	
	Both	☐		☐		☐	
	Other ______	☐		☐		☐	
Type of Element		Check if used	Percent used in analysis	Check if used	Percent used in analysis	Check if used	Percent used in analysis
One Dimensional	Rod	☐	____ %	☐	____ %	☐	____ %
	Spring	☐	____	☐	____	☐	____
	Beam	☐	____	☐	____	☐	____
	Gap	☐	____	☐	____	☐	____
	Other ______	☐	____	☐	____	☐	____
Two Dimensional	Triangular						
	- with one mid-side node	☐	____ %	☐	____ %	☐	____ %
	- with two mid-side nodes	☐	____	☐	____	☐	____
	Other ______	☐	____	☐	____	☐	____
Three Dimensional	Pyramid	☐	____ %	☐	____ %	☐	____ %
	Wedge	☐	____	☐	____	☐	____
	Brick	☐	____	☐	____	☐	____
	With one mid-side node	☐	____	☐	____	☐	____
	With two mid-side nodes	☐	____	☐	____	☐	____
	Other ______	☐	____	☐	____	☐	____

INPUT

1.e. What are typical sizes of analysis models for each product?

Product	Typical Size	
	Number of Nodes	Number of Elements
1		
2		
3		

2. Please indicate the relative importance of geometry data generation versus non-geometry data generation (such as loads, constants, etc.) in computer aided analysis pre and postprocessor software systems.

Geometry data generation is more important than non-geometry data generation

☐ 0% ☐ 25% ☐ 50% ☐ 100%
☐ 200% ☐ 500% ☐ 1000%
☐ >1000% ☐ ____%

3. Please estimate the portion of drawings currently used in analysis that are generated by a CAD system.

☐ Don't know ☐ 0% ☐ <10% ☐ 10 - 25% ☐ 26-50% ☐ 51-75%
☐ >75% ☐ ____%

INPUT

4. What are your current plans, if any, for acquiring new automated facilities for design and analysis?

Planned Company Products and Applications	Design and Analysis Computer Assisted Aids						
	Software Products		Computer Systems			In-House	Outside Services Vendor Name
				Model			
	Name	Vendor	Vendor	Large Mainframe	Mid-Size Dedicated System		

Comments: ______________________

____

____

5. It has been suggested that minicomputers are/will be capable of handling complex structural programs.

a. Do you concur? ☐ Yes ☐ No

b. If yes, do you believe a 16-bit processor can do the job?

☐ Yes ☐ No

Comments: ______________________________

____

____

____

c. Do you have any long-term plans to use minis for analysis?

☐ Yes ☐ No

If yes, please describe: ______________________________

____

____

6. In your analysis process, please estimate how labor effort is split between the preprocessing phase (i.e., preparing input data) and the postprocessing phase (i.e., evaluating results). Assume zero labor is associated with running the analysis program.

Preprocessing _____ %　　　Postprocessing _____ %

b. Describe in your own terms what system features you feel would be of most help to you in improving productivity in the preprocessing phase:

____

____

____

____

c. In the postprocessing phase: ______________________________

____

____

____

INPUT

6.d. To what level should preprocessor and/or postprocessor systems be linked to the analysis program (e.g., NASTRAN, ANSYS, etc.)?

____

____

____

____

7.a. In your engineering department, what is the labor split between design and structural analysis?

Design _____ % or ________________
number of persons

Structural Analysis _____ % or ________________
number of persons

b. Do you perceive a need for significant productivity improvement in the analysis phase?

☐ Yes ☐ No

c. Do you believe that both design and analysis tasks should be integrated in a single system? For example, would the ability to recall a past geometry from a data base created in the design phase be of significant benefit to you in the analysis phase?

☐ Yes ☐ No

Comments: __________________________________

____

____

INPU

7.d. Alternatively, do you see pre and postprocessors as part of an automated design and development package, or in a standalone configuration?

☐ Part of an integrated automated design and development system

☐ Structural analysis will remain a separate function

Comments: ______________________________

____

____

e. If integrated, to what level should the analysis software or system be linked to design systems or software?

____

____

____

____

____

____

8.a. Do you believe that a color graphics display would significantly improve your productivity?

☐ Yes ☐ No

If yes, please explain: ______________________________

____

____

____

b. Can you estimate how much time you would save (relative to what you are spending now) if you had color displays available in the pre or post-processing phase?

☐ Don't know

☐ Time Saved

☐ < 5% ☐ 5-10% ☐ 10-20% ☐ >20%

9. In using an interactive graphics system for pre and postprocessing, can you comment on your terminal response time requirements?

____

____

____

____

INP

10. Please independently rate on a scale of 0 - 10, where 10 is most important the following pre and postprocessor system features in terms of their value to your analysis operations:

System Feature	Ranking 0-10	Comments
MODEL GENERATION Surface Intersection		
Parametric Modeling		
Fully automated meshing or remeshing (Please give some indication of frequency, area of stress concentration, etc.)		
Semi-automated meshing via replication or data generation		
Manual meshing (conventional and image form)		
USER INTERFACE Digitizing data via tablet		
Menu function selection via digitizer		
Multiple split screen display		
MODEL VERIFICATION Planarity Check		
Aspect ratio check		
Boundary display		
Hidden line removal		
Element shrink in plotting		
Labeling nodes and elements		
Labeling property and materials		

INPUT

10. (Cont.)

System Feature	Rating 0 - 10	Comments
NON-GEOMETRIC DATA GENERATION Loads (please comment on types)		
Constraints (Please comment on types)		
Properties		
Materials		
Solution selection (Please comment on types)		
Output options (Please comment on kinds/types)		
POSTPROCESSING X-Y Plots (Please comment on types)		
Contour plots (Please comment on types)		
Max/Min Searches		
Data Sorting		
Design code processing (Please comment on types of codes)		
Load case combination		
Member selection (table look up)		
Animation of dynamic results		

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10. (Cont.)

System Feature	Rating 0 - 10	Comments
MISCELLANEOUS Standard member tables (e.g., AISC beams) (Please give comments on standard members)		
Bandwidth/wavefront optimizer		
Physical property calculation		
Length		
Area		
Volume		
Inertia		
OTHER ____________ (Please give comments on additional features)		

THANK YOU ! ! !